Mars 2024/2026 Pathfinder Mission: Mars Architectures, Systems, & Technologies for Exploration and Resources

Completed Technology Project (2015 - 2016)

Project Introduction

Integrate In Situ Resource Utilization (ISRU) sub-systems and examine advanced capabilities and technologies to verify **Mars 2024 Forward** architecture precursor pathfinder options:

Integrated spacecraft/surface infrastructure fluid architecture: propulsion, power, life support

• Power system feed and propellant scavenging from propulsion system

• High quality oxygen for life support and EVA

Fluid/cryogenic zero-loss transfer and long-term storage

• Rapid depot-to-rover/spacecraft

• Slow ISRU plant-to-ascent vehicle

Integration of ISRU consumable production

• Oxygen only from Mars atmosphere carbon dioxide

• Oxygen, fuel, water, from extraterrestrial soil/regolith

Test bed to evaluate long duration life, operations, maintenance on hardware, sensors, and autonomy

Focus on integration of hardware and concepts developed under and funded from other projects

–Funding for hardware and services to enable integration and testing

–**Finish development of shelved hardware to meet integrated test needs (includes KSC umbilical and regolith feed system)**

Increase scope and fidelity of integrated architectures in a stepwise/phased approach

–**Initially focus on existing/near-ready hardware for early integration and lessons-learned**

–Allow upgrades as hardware and funding become available.

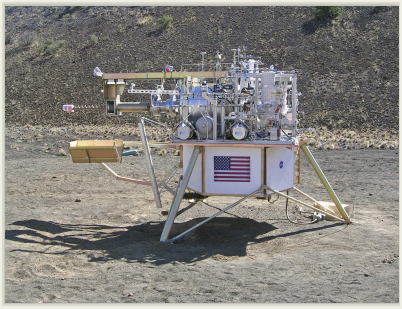
Examine critical architecture modes of integration and operation:

–Mode 1: Solid Oxide Fuel Cell (SOFC) from LO_2/CH_4 Tanks

–Mode 2: Liquefy & Store ISRU Produced Propellants before Transfer

–Mode 3: Zero-Loss Cryogenic LO_2/CH_4 Fluid Storage and Transfer

–Mode 4: Integrate all Modes of operation for long-term ground test



An ISRU payload precursor mission lander

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Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Center Independent Research & Development: KSC IRAD

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Anticipated Benefits

Provide a focal point for advanced development in separate disciplines and development areas:

–Across the agency: NASA centers and technology development programs (AES, STMD, SBIR, CIF)

–For external partnerships: Other government agencies, industry, academia, international

KSC has been working on ISRU technologies and systems since 1996 (19 years). KSC is participating in the Mars 2024/2026 Pathfinder technology maturation project since it will integrate and test **an ISRU "end to end" system** that will influence future Mars ISRU precursor payloads and human systems.

KSC has substantial ISRU hardware that was shelved **and can be completed at a low cost to contribute to the Mars 2024/2026 mission technology development effort.**

This is an evolutionary process to refine ISRU technology, increase confidence and scale up to support future sample return or crewed missions to Mars. **There is potential for the Mars 2024/2026 Sample Return Mission to be powered by propellants produced by an ISRU payload and a combined ISRU system test would be the initial step in refining the design and moving towards a flight system demonstrating ISRU.** The Mars 2024/2026 ISRU mission would reduce risk for larger scale human Mars missions*. Mars DRA 5.0 depends on ISRU as an enabling technology.* Similar ISRU hardware could be used at the lunar poles to convert lunar CO into storable methane fuel using local water ice as a source of hydrogen and oxygen.

Propellant made with ISRU technologies developed by NASA can be made in space and could become a commercial product which will kick start the space ecnomomy. Other ISRU technologies will then allow manufacturing in space which will also advance economic activity and human prosperity.

Project Management

Program Manager:

Barbara L Brown

Project Manager:

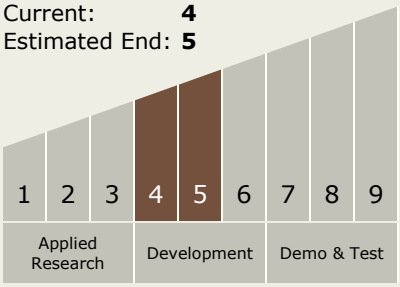
Nancy P Zeitlin

Principal Investigators:

Robert P Mueller
Anthony C Muscatello

Technology Maturity (TRL)

Start: **4**
Current: **4**
Estimated End: **5**



Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.3 Resource Processing for Production of Mission Consumables

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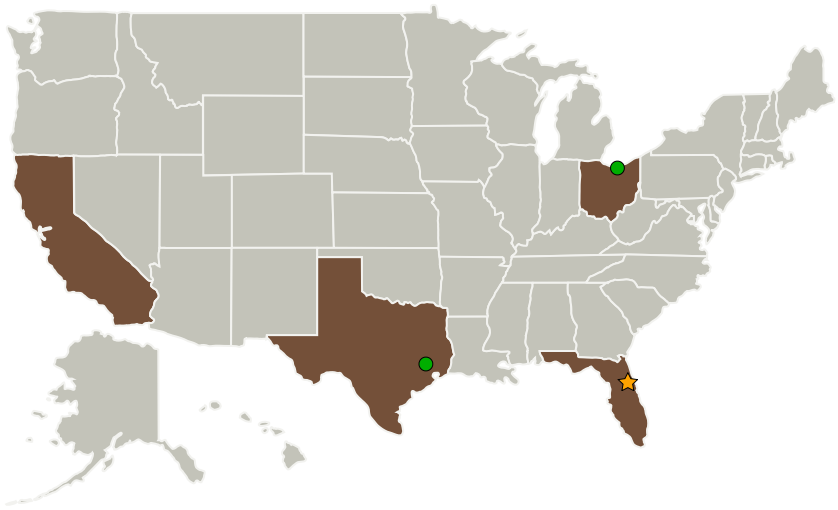
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida
●Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio
●Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Co-Funding Partners	Type	Location
SpaceX	Industry	

Primary U.S. Work Locations	
California	Florida
Ohio	Texas

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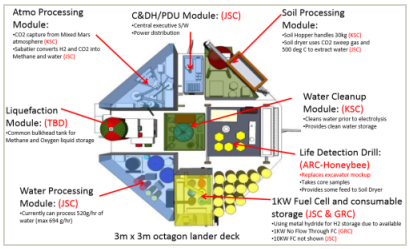
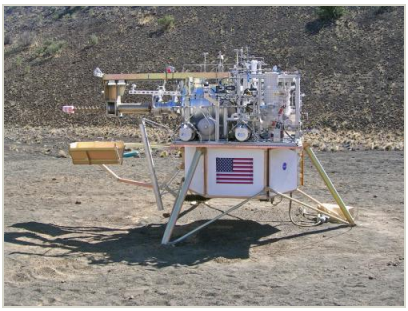
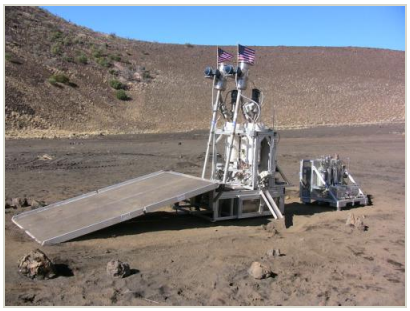
Images



Concept for Lander Deck Payloads
These payloads could be part of a Mars 2026 Mission
(https://techport.nasa.gov/image/16585)



PILOT ISRU Oxygen Production Plant Prototype
An ISRU payload precursor mission lander
(https://techport.nasa.gov/image/16584)



ROxygen ISRU Demonstration Prototype
This is a hydrogen reduction ISRU plant for making oxygen from Regolith
(https://techport.nasa.gov/image/16583)